## REMARKS

By this Amendment, Applicant hereby cancels claim 1, without prejudice, and adds claims 11 and 12. Accordingly, claims 2-12 are all of the claims pending in the application.

I. Formal Matters

Applicant thanks the Examiner for initialing and returning the form PTO/SB/08 submitted with the Information Disclosure Statement of January 17, 2006, indicating that the documents cited therein have been considered.

II. Summary of the Office Action

The Examiner rejected claims 2-10 under 35 U.S.C. § 112, second paragraph. The Examiner rejected claims 2 and 4-7 under 35 U.S.C. § 102(a), claims 1-9 under 35 U.S.C. § 102(b), and claims 1-10 under 35 U.S.C. § 103(a).

III. Claim Rejections under 35 U.S.C. § 112, Second Paragraph

Claims 2-10 are rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter which the applicant regards as the invention.

Applicant hereby amends claim 2, without narrowing, for purposes of clarity. Applicant respectfully submits that claim 2 is definite and requests that the Examiner withdraw the 35 U.S.C. § 112, second paragraph rejection.

The Examiner alleges that, with respect to claim 6, there is no antecedent basis for "the electrically conductive bands." Applicant respectfully disagrees and points the Examiner to claim 2, which recites, *inter alia*, "at least one tread layer consisting of a tread rubber made of a low-conductive rubber and an electrically conductive band." Claim 6 recites, *inter alia*, "at least

two layers as the tread layer." Accordingly, Applicant respectfully submits that the feature, "the electrically conductive bands," has proper antecedent basis and that claim 6 is definite. Applicant respectfully requests that the Examiner withdraw the 35 U.S.C. § 112, second paragraph rejection.

The Examiner also alleges that claims 7-10 are incomplete and therefore indefinite because the steps recited in claims 7-10 fail to produce the tire of claim 1. The Examiner points out that there is no mention of the belt in claims 7-10. Applicant respectfully disagrees that claims 7-10 are indefinite. Claims 7 and 8 are hereby rewritten into independent form for reasons unrelated to the rejection. Applicant respectfully submits that the breadth of the claims should not be equated with indefiniteness (*see* MPEP § 2173.04). Applicant respectfully submits that claims 7-10 are clear and definite and requests that the Examiner withdraw the 35 U.S.C. § 112, second paragraph rejection.

IV. Claim Rejections under 35 U.S.C. § 102

Claims 1, 6, and 8 are rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by Japanese Patent Publication No. 2001-047525 (hereinafter "JP '525"). Claims 2 and 4-7 are rejected under 35 U.S.C. § 102(a) as allegedly being anticipated by Japanese Patent Publication No. 2003-326614 (hereinafter "JP '614"). Claims 2 and 4-7 are rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by Japanese Patent Publication No. 11-129713 (hereinafter "JP '713"). Applicant respectfully traverses these rejections and respectfully requests the Examiner to reconsider these rejections at least in light of the comments which follow.

***JP '525***

Claims 6 and 8 recite, *inter alia*, "the electrically conductive band is made of a high-conductive thin annular rubber sheet." The Examiner alleges that JP '525 discloses this feature. Applicant respectfully disagrees.

The Examiner alleges that the high-conductive thin annular rubber sheet reads on the thin high conductivity rubber composition layer E (*see* page 3 of the Office Action). But the rubber composition layer E is not a thin annular rubber sheet. Instead, the rubber composition layer E is formed by making a break that is filled with liquefied cement (*see* paragraph 0035 of JP '525). According to JP '525, a knife edge makes a break in the tread rubber, and a dropping device drops liquefied cement of an unvulcanized high conductivity rubber composition into the break (*see* paragraph 0013). Accordingly, rather than teaching that the electrically conductive band is made of a high-conductive thin annular rubber sheet, JP '525 teaches that an electrically conductive band is made of liquefied cement dropped by a dropping device into a break.

For at least the reasons discussed above, Applicant respectfully submits that claims 6 and 8 are patentable over JP '525. Applicant respectfully submits that the rejection is moot with respect to claim 1 because the claim is canceled, without prejudice.

***JP '614***

Applicant submits herewith an English language translation of the foreign priority document Japanese Patent Application No. 2003-197888 for the present application, thereby perfecting the claim to benefit from a priority date of July 16, 2003. Applicant respectfully submits that the priority document fully supports at least the pending independent claims.

The earliest effective date of JP '614 is November 19, 2003. Since JP '614 has an effective date later than the perfected priority date of the present application, JP '614 is not prior art with respect to any of the claims of the present application.

Applicant respectfully submits that the rejections of claims 2 and 4-7 under 35 U.S.C. § 102(a) as being anticipated by JP '614 are moot because the rejections are based on a document that is not a prior art reference. Applicant respectfully requests that the Examiner withdraw these rejections.

***JP '713***

Turning to claim 2, the Examiner alleges that JP '713 discloses "the electrically conductive band is made of a high-conductive thin annular rubber sheet and connected to both ends of the side face in the radial direction so as to extend over a widthwise region ranging from a part of a top face of the first tread rubber portion toward a part of a bottom face of the second tread rubber portion separated by the electrically conductive band," as recited, *inter alia*, in claim 2. Applicant respectfully disagrees.

The conductive rubber layer according to JP '713 does not appear to extend over a part of a top face of the first tread rubber portion toward a part of a bottom face of a second tread rubber portion (*see* FIGS. 1-6). Instead, according to JP '713, the tread part is divided into two from the cap rubber layer 1 to the base rubber layer 2 in a tire width direction, and it is arranged so that the conductive rubber layer 3 may extend in a hoop direction at this dividing part (*see* paragraph 0019 of JP '713). Thus, instead of extending over a part of a top face of the first tread rubber portion toward a part of a bottom face of a second tread rubber portion, according to JP '713, the conductive rubber layer appears to only extend through the dividing part.

For at least the reasons discussed above, Applicant respectfully submits that claim 2 is patentable over JP '713. Applicant respectfully submits that claims 4 and 5 are patentable over JP '713 at least by virtue of their dependency on claim 2.

JP '713 does not disclose "the tread rubber is made of a low-conductive continuous rubber ribbon," as recited, *inter alia*, in claims 6 and 7. At least for this reason, Applicant respectfully submits that claims 6 and 7 are patentable over JP '713.

V. Claim Rejections under 35 U.S.C. § 102(b), or, in the Alternative, 35 U.S.C. § 103(a)

Claims 1-3, 5, and 7-9 are rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as allegedly being obvious over U.S. Patent Application Publication No. 2002/0007893 to Koyama et al. (hereinafter "Koyama"). Applicant respectfully traverses these rejections and respectfully requests the Examiner to reconsider these rejections at least in light of the comments which follow.

Applicant respectfully submits that the rejections over Koyama are moot with respect to claim 1, which is canceled, without prejudice.

Claims 2, 7, and 8 recite, *inter alia*, "the electrically conductive band is made of a high-conductive thin annular rubber sheet." The Examiner alleges that Koyama discloses this feature. Applicant respectfully disagrees.

According to Koyama, the electrically conductive layer 9 may be formed by winding the rubber ribbon 10 on the tire material (*see* paragraph 0046 of Koyama). Thus, the electrically conductive layer is made by twisting a rubber ribbon, rather than a thin annular rubber sheet. A person of ordinary skill in the art would understand that a twisted rubber ribbon is not the same as a thin annular rubber sheet.

Further advantages of the invention recited in claim 2 are described in paragraphs 0012 and 0013 of the specification. In particular, the tire of claim 2 has an electrically conductive band which extends over a widthwise region ranging from a part of a top face of the first tread rubber portion toward a part of a bottom face of a second tread rubber portion. In contrast, the tire of the Koyama reference has an electrically conductive layer which extends generally in the radial direction. The electrically conductive band of the present invention ensures the electric contact with an electrically conductive portion of the adjoining tire constituting layer even if the position of the electrically conductive band in the widthwise direction is somewhat changed due to the scattering in the production, which is an advantageous effect over the tire of the Koyama reference.

Further advantages of the invention recited in claim 7 are described in paragraph 0025 of the specification. Specifically, the thickness of the electrically conductive band in the widthwise direction can be optimized by adjusting the thickness of the sheet to be wound. Furthermore, the width of the sheet to be wound is adjusted to form the electrically conductive band exceeding the side face of the tread rubber and widely exposing on the top face and bottom face of the tread layer, ensuring electric continuity between the layers.

Further advantages of the invention recited in claim 8 are described in paragraph 0027 of the specification. Specifically, the deterioration of the uniformity due to the joint portion on the periphery can be prevented and the production is possible in a multi-sized mixed production system.

At least for these reasons, Applicant respectfully submits that claims 2, 7, and 8 are patentable over Koyama. Applicant respectfully submits that claims 3, 5, and 9 are patentable over Koyama at least by virtue of their dependency on claim 2 or 8.

VI. Claim Rejections under 35 U.S.C. § 103(a)

Claims 4 and 5 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Koyama in view of JP '713. Claim 6 is rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Koyama in view of JP '713, U.S. Patent No. 6,951,233 to Calvar et al. (hereinafter "Calvar '233"), and U.S. Patent No. 6,834,693 to Calvar et al. (hereinafter "Calvar '693"). Claims 4, 5 and 6 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Koyama in view of JP '614. Claim 10 is rejected under 35 U.S.C. § 103(a) allegedly being unpatentable over Koyama in view of European Patent Application Publication No. 1201397 (hereinafter "EP '397").

Applicant respectfully submits that claims 4-6 and 10 are patentable over Koyama at least by virtue of their dependency on claim 2 or 7. The disclosure of JP '713, Calvar '233, Calvar '693, JP '614, and EP '397 does not cure the deficiencies of Koyama as discussed above with respect to claims 2 and 7. Accordingly, Applicant respectfully submits that claims 4-6 and 10 are patentable over Koyama in view of the various combinations of JP '713, Calvar '233, Calvar '693, JP '614, and EP '397.

VIII. Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly invited to contact the undersigned attorney at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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WASHINGTON OFFICE
23373
CUSTOMER NUMBER

Date: July 28, 2008

**PATENT APPLICATION**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re application of

Yuichiro OGAWA

Appln. No.: 10/564,733

Confirmation No.: 9813

Filed: January 17, 2006

For: TIRE AND TIRE PRODUCING METHOD

Docket No: Q92702

Group Art Unit: 1791

Examiner: Steven D. Maki

**PETITION FOR EXTENSION OF TIME UNDER 37 C.F.R. § 1.136**

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Pursuant to 37 C.F.R. § 1.136, Applicant hereby petitions for an extension of time of one month, extending the time for responding to the Office Action of March 28, 2008 to July 28, 2008.

The statutory fee of $120.00 is being charged to Deposit Account No. 19-4880 via EFS Payment Screen. The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account. A duplicate copy of this sheet is enclosed.

Respectfully submitted,

/Eric S. Barr/

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**EXCESS CLAIM FEE PAYMENT LETTER**

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

An Amendment Under 37 C.F.R. § 1.111 is attached hereto for concurrent filing in the above-identified application. The resulting excess claim fee has been calculated as shown below:

| | After Amendment | | Highest No. Previously Paid For | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| All Claims | 11 | - | 20 | = | | X | $50.00 | = | $.00 |
| Independent | 5 | - | 3 | = | 2 | X | $210.00 | = | $420.00 |
| | | | | | **TOTAL** | | | = | **$420.00** |

The statutory fee of $420.00 is being charged to Deposit Account No. 19-4880 via EFS Payment Screen. The USPTO is also directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

/Eric S. Barr/

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WASHINGTON OFFICE
23373
CUSTOMER NUMBER

Date: July 28, 2008

# SWORN TRANSLATION

I, Reiko KASHIMA, hereby declare and state that I am knowledgeable of each of the English and Japanese languages and that I made the attached translation of the certified copy of Japanese Patent Application No. 2003-197888 from the Japanese language into English language and that I believe my attached translation to be accurate, true and correct to the best of my knowledge and ability.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: July 7, 2008

Declarant: Reiko Kashima

Reiko KASHIMA

[Identification of Document] SPECIFICATION

[Title of the Invention] Tire and tire producing method

[Claims]

[Claim 1]

A tire comprising at least one tread layer consisting of a tread rubber made of a low-conductive rubber and an electrically conductive band arranged in widthwise middle portion of the tread rubber and constituting at least a part of a conductive path from a belt to a treading face of a tread

in which the tread rubber is made of a low-conductive continuous rubber ribbon circumferentially wound plural times, and the electrically conductive band is made of a high-conductive thin annular rubber sheet.

[Claim 2]

A tire comprising at least one tread layer consisting of a tread rubber made of a low-conductive rubber and an electrically conductive band arranged in widthwise middle portion of the tread rubber and constituting at least a part of a conductive path from a belt to a treading face of a tread

in which a first tread rubber portion of the tread rubber separated by the electrically conductive band is arranged so as to orient a side face thereof contacting with the electrically conductive band outward in the radial direction, and the electrically conductive band is made of a high-conductive thin annular rubber sheet and connected to both ends of the side face in the radial direction so as to extend over a widthwise region ranging from a part of a top face of the first tread rubber portion toward a part of a bottom face of a second tread rubber portion separated by the electrically conductive band.

[Claim 3]

A tire according to claim 2, wherein the tread rubber is made of a low-conductive continuous rubber ribbon circumferentially wound plural times.

[Claim 4]

A tire according to claim 2 or 3, wherein the side face of the first tread rubber portion contacting with the electrically conductive band has an average inclination angle of 45-75 deg. with respect to an equatorial plane of the tire.

[Claim 5]

A tire according to any one of claims 2 to 4, wherein the tread layer is arranged as at least innermost layer in the radial direction.

[Claim 6]

A tire according to any one of claims 1 to 5, wherein at least two layers as the tread layer are arranged adjacent to each other inside and outside in the radial direction and the electrically conductive bands in these tread layers are contacted with each other over the full periphery.

[Claim 7]

A method of producing a tire as claimed in any one of claims 1 to 6,

which comprises winding a thin high-conductive uncured rubber sheet on an outer periphery of a rotating, displacing tire raw member one times to form an uncured electrically conductive band.

[Claim 8]

A method of producing a tire as claimed in any one of claims 1 to 6,

which comprises circumferentially winding a continuous low-conductive uncured rubber ribbon plural times to form an uncured tread rubber.

[Claim 9]

A method according to claim 8, wherein an uncured first tread rubber portion is formed on the outer periphery of the rotating, displacing tire raw member by circumferentially winding a continuous low-conductive uncured rubber ribbon plural times, and then an uncured electrically conductive band is formed by winding a high-conductive uncured rubber sheet on a widthwise region inclusive of a side face of the uncured first tread rubber portion one times, and thereafter uncured second tread rubber portion is formed on outer peripheries of the rotating,

displacing electrically conductive band and tire raw member by circumferentially winding a continuous low-conductive uncured rubber ribbon plural times.

[Claim 10]

A method according to claim 7 or 9, wherein the high-conductive uncured rubber sheet is formed by rolling in a calendar.

[Detailed Explanation of the Invention]

[0001]

[Technical Field of the Invention]

This invention relates to a tire capable of sufficiently discharging static electricity generated in a vehicle toward a road surface while reducing the rolling resistance of the tire and a method of producing the same.

[0002]

[Background Art]

In order to reduce the rolling resistance of the tire, a greater part of carbon black compounded in a tread rubber tends to be positively replaced with silica having a low hysteresis loss characteristic. However, a tread rubber compounded with a great amount of silica becomes higher in the value of electric resistance, and hence there is caused a problem that static electricity generated in a vehicle hardly discharge through the tire toward a road surface.

[0003]

For the purpose of ensuring the discharge property of the tread rubber is proposed a tire wherein a tread is constructed with at least one tread layer comprising a tread rubber having a low electric conduction and an electrically conductive band arranged in a widthwise middle portion of such a tread rubber and constituting at least a part of a conductive path from a belt to a treading face of the tread. A first proposal is a tire wherein each of the tread rubber and the electrically conductive band constituting the tread layer is made from an annular rubber member of one-piece structure (see patent literature 1, for example), and a second proposal is a tire wherein each of the tread

rubber and the electrically conductive band constituting the tread layer is made from a rubber ribbon wound plural times in a circumferential direction of the tread (for example, see patent literature 2).

[0004]

However, these proposals have the following problems. As to the first proposal, the tread rubber is naturally formed by winding an elongate rubber extruded through an orifice corresponding to a shape of a tire product on a full periphery of a tire once, so that the thus formed tread rubber has a joint portion at one place of the periphery, which is a cause of deteriorating the tire uniformity. Also, the formation of such a tread rubber needs a large-size extruder but also the orifice set in the extruder once can not be easily exchanged with another new orifice, so that there is a drawback that this proposal can not be applied to an efficient system of mixedly producing tires of various sizes while reducing intermediate stock.

[0005]

The problem of the second proposal is as follows. The material of the electrically conductive band is different from that of the tread rubber naturally optimized toward the function inherent to the tread, and hence it is preferable to become thin as far as a thickness in the widthwise direction of the tire enough to guarantee the electric conduction is ensured. However, the electrically conductive band of the second proposal has a problem that the band has a structure of winding and laminating a continuous uncured conductive rubber ribbon and the thickness becomes considerably thicker than the naturally required thickness.

[0006]

Furthermore, at least one of upper face and lower face in the tread layer is an adjacent face adjoining to the other tire constituting layer inward or outward in the radial direction, so that the electrically conductive band is exposed to the adjacent face over the full periphery and is necessary to surely hold the contact with an electrically conductive portion of the adjoining tire constituting layer. In the first and

second proposals, however, the electrically conductive band is exposed to the adjacent face as only a narrow-width line, and in this case, a portion not exposing to the adjacent face may be caused due to the scattering in the production. Also, when two of the tread layers having the above structure are laminated, the exposing portions of the electrically conductive bands are not matched with each other in the widthwise direction or it is difficult to ensure the electric conduction among these layers. If it is intended to control the scattering in the production for preventing this drawback, a production equipment of a high precision is required and hence there is caused a problem rendering a significant cost-up.

[0007]

[Patent literature 1]

JP11-151907

[Patent literature 2]

JP2002-96402

[0008]

[Problems to be Solved by the Invention]

The invention is made considering the above problems and is to provide a tire in which the tire uniformity is improved in the tire comprising a tread layer consisting of a tread rubber and an electrically conductive band arranged in a widthwise middle portion thereof and the production is possible in a multi-size mixed production system and the widthwise thickness of the electrically conductive band can be controlled at minimum and a conductive path from a belt to a treading face can be surely formed in a low cost as well as a method of producing such a tire.

[0009]

The invention is accomplished for achieving the above object, and the summary, construction and function are as follows.

[0010]

A tire described in claim 1 comprising at least one tread layer consisting of a tread rubber made of a low-conductive rubber and an electrically conductive band arranged in widthwise middle portion of the

tread rubber and constituting at least a part of a conductive path from a belt to a treading face of a tread in which the tread rubber is made of a low-conductive continuous rubber ribbon circumferentially wound plural times, and the electrically conductive band is made of a high-conductive thin annular rubber sheet.

[0011]

In accordance with the tire related to claim 1, the tread rubber is constructed by the low-conductive continuous rubber ribbon circumferentially wound plural times, so that there is no joint portion extending over the full width of the tread rubber and the uniformity can be improved. Also, tread rubbers having various sectional shapes can be formed by controlling the winding arrangement of the same rubber ribbon and it is possible to conduct the production in a multi-size mixed production system. Further, according to this tire, the electrically conductive band is constructed by the high-conductive thin annular rubber sheet, so that the thickness of the sheet is made to a minimum level enough to act as the electrically conductive band, whereby the bad influence on the function inherent to the tread rubber can be controlled to a minimum level.

[0012]

A tire described in claim 2 comprising at least one tread layer consisting of a tread rubber made of a low-conductive rubber and an electrically conductive band arranged in widthwise middle portion of the tread rubber and constituting at least a part of a conductive path from a belt to a treading face of a tread in which a first tread rubber portion of the tread rubber separated by the electrically conductive band is arranged so as to orient a side face thereof contacting with the electrically conductive band outward in the radial direction, and the electrically conductive band is made of a high-conductive thin annular rubber sheet and connected to both ends of the side face in the radial direction so as to extend over a widthwise region ranging from a part of a top face of the first tread rubber portion toward a part of a bottom face of a second tread rubber portion separated by the electrically conductive band.

[0013]

In Accordance with this tire, since the electrically conductive band is made of a high-conductive thin annular rubber sheet, the thickness of the sheet is made to a minimum level enough to act as the electrically conductive band, whereby the bad influence on the function inherent to the tread rubber can be controlled to a minimum level. Also, the electrically conductive band is extended over the widthwise region ranging from the top face of the first tread rubber portion toward the bottom face of the second tread rubber portion, so that even if the position of the electrically conductive band in the widthwise direction is somewhat changed due to the scattering in the production, the electric contact with an electrically conductive portion of the adjoining tire constituting layer can be ensured, and hence a tire capable of holding the conductive path from the belt to the treading face can be provided cheaply.

[0014]

Furthermore, according to the tire, the side face of the first tread rubber portion in the tire contacting with the electrically conductive band is oriented outward in the radial direction, so that it is easy to form the uncured electrically conductive band by winding the uncured conductive thin rubber sheet.

[0015]

As described in claim 2, a tire described in claim 3 wherein the tread rubber is made of a low-conductive continuous rubber ribbon circumferentially wound plural times.

[0016]

According to this tire, the electric conduction can be ensured at a low cost but also since the tread rubber is made of the low-conductive continuous rubber ribbon circumferentially wound plural times, the high uniformity level can be provided as previously mentioned and the production in the multi-size mixed production system becomes possible.

[0017]

In accordance with what is described in claim 2 or 3, a tire described in claim 4 wherein the side face of the first tread rubber portion contacting with the electrically conductive band has an average inclination angle of 45-75 deg. with respect to an equatorial plane of the tire.

[0018]

When the average inclination angle of the side face of the first tread rubber portion with respect to the equatorial plane is less than 45 deg., it becomes difficult to wind the uncured conductive thin rubber sheet, while when it exceeds 75 deg., the extending range of the electrically conductive band in the widthwise direction becomes wider, which causes a possibility of obstructing the performances inherent to the tread rubber.

[0019]

In accordance with the description in any one of claims 2 to 4, a tire described in claim 5 wherein the tread layer is arranged as at least innermost layer in the radial direction.

[0020]

The electrically conductive band in the radically innermost tread layer is required to hold the electric continuity with the tread under cushion or belt adjoining thereto inward in the radial direction, so that according to this tire, the electrically conductive band in the innermost tread layer is extended to the widthwise range ranging to the bottom face of the second tread rubber portion and can ensure the electric continuity with such a portion.

[0021]

In accordance with the description in any one of claims 1 to 5, a tire described in claim 6, wherein at least two layers as the tread layer are arranged adjacent to each other inside and outside in the radial direction and the electrically conductive bands in these tread layers are contacted with each other over the full periphery.

[0022]

When the tread is comprised of two or more tread layers, it is

important to surely hold the electric continuity between the electrically conductive bands in the tread layers adjoining to each other inside and outside in the radial direction. According to this tire, the electrically conductive band in the tread layer located inside in the radial direction is extended to the widthwise region ranging to the top face of the first tread rubber portion, and the electrically conductive band in the tread layer located outside in the radial direction is extended to the widthwise region ranging to the bottom face of the second tread rubber portion, so that the electric continuity between these electrically conductive bands can be ensured by allowing the fluctuation based on the scattering of the electrically conductive bands in these tread layers in the widthwise direction.

[0023]

A tire producing method described in claim 7 is a tire producing method described in any one of the claims 1 to 6, which comprises winding a thin high-conductive uncured rubber sheet on an outer periphery of a rotating, displacing tire raw member one times to form an uncured electrically conductive band.

[0024]

There are proposed some methods for the formation of the uncured electrically conductive band made of the high-conductive thin annular rubber sheet. For example, there is a method wherein an integrally united elongate of a tread rubber and an electrically conductive band formed by integrally extruding rubber for an electrically conductive band portion and the tread rubber or by applying a conductive rubber cement to a side face of an extruded elongate tread rubber is wound on the tire raw member at a building step to form the uncured electrically conductive band. This method assumes the extrusion of the tread rubber having a sectional shape corresponding to a shape of a product, and hence needs a large-size extruder as previously mentioned and can not solve problems that the deterioration of the uniformity resulted from the joint portion in the circumferential direction can not be prevented and the production is impossible in the multi-size mixed production system.

[0025]

Also, the other proposal is a method wherein uncured shaped bodies of the tread rubber to be arranged on both widthwise sides of the electrically conductive band are formed on the rotating tire raw member and a cement is poured therebetween to form an uncured electrically conductive band. This method takes a long time for drying the cement and has a problem that the productivity is largely damaged.

[0026]

According to the tire producing method of this invention, the uncured electrically conductive band is formed by winding a thin high-conductive uncured rubber sheet on an outer periphery of a rotating, displacing tire raw member one times, so that the problems of the above proposals can be solved. Also, the thickness of the electrically conductive band in the widthwise direction can be optimized by adjusting the thickness of the sheet to be wound. Furthermore, the width of the sheet to be wound is adjusted to form the electrically conductive band exceeding the side face of the tread rubber and widely exposing on the top face and bottom face of the tread layer, whereby the electric continuity between the layers can be ensured.

[0027]

A tire producing method described in claim 8 is a tire producing method described in any one of the claims 1 to 6, which comprises circumferentially winding a continuous low-conductive uncured rubber ribbon plural times to form an uncured tread rubber.

[0028]

According to this tire producing method, the uncured tread rubber is formed by circumferentially winding a continuous low-conductive uncured rubber ribbon plural times, so that the tread rubber can be formed by circumferentially winding the low-conductive continuous rubber ribbon plural times, and hence the large-size extruder is useless as previously mentioned and the deterioration of the uniformity due to the joint portion on the periphery can be prevented and the production is possible in the multi-size mixed production system.

[0029]

In accordance with the description in claim 8, a tire producing method described in claim 9, wherein an uncured first tread rubber portion is formed on the outer periphery of the rotating, displacing tire raw member by circumferentially winding a continuous low-conductive uncured rubber ribbon plural times, and then an uncured electrically conductive band is formed by winding a high-conductive uncured rubber sheet on a widthwise region inclusive of a side face of the uncured first tread rubber portion one times, and thereafter uncured second tread rubber portion is formed on outer peripheries of the rotating, displacing electrically conductive band and tire raw member by circumferentially winding a continuous low-conductive uncured rubber ribbon plural times.

[0030]

According to this invention, after the uncured first tread rubber portion is formed on the outer periphery of the tire raw member, the high-conductive uncured rubber sheet is wound on the outer periphery of the side face of this tread rubber portion orienting outward in the radial direction, so that the winding of this sheet can be made easy. Also, the winding of the high-conductive rubber sheet is carried out before the formation of the second tread rubber portion, so that the high-conductive uncured rubber sheet can be wound so as to extend over the widthwise region ranging from the top face of the first tread rubber portion through the side face of the first tread rubber portion to the bottom face of the second tread rubber portion, and hence the electric continuity between the layers can be ensured.

[0031]

In accordance with the description in claim 7 or 9, a tire producing method described in claim 10, wherein the high-conductive uncured rubber sheet is formed by rolling in a calendar.

[0032]

This tire producing method, the high-conductive, uncured rubber sheet is formed by rolling in the calendar, so that an elongate sheet having a very thin thickness can be formed as compared with the

case of extruding the sheet through a given orifice, and hence the thickness of the electrically conductive band in the widthwise direction can be optimized.

[0033]

[Embodiment of the Invention]

An embodiment of the invention will be described with reference to FIGS. 1-6. FIG. 1 is a meridional section view showing a tread portion of a tire according to an embodiment of the invention, and FIG. 2 is a section view showing a detail of a portion "d" in FIG. 1. The tire 1 comprises a belt 6, a tread under cushion 5 arranged on an outer periphery of the belt 6 and sidewall portions 7 disposed on both sides thereof in the widthwise direction, in which a base tread layer 3 and a cap tread layer 4 disposed outside thereof are arranged outward in the radial direction thereof as a tread layer constituting a tread 2. The base tread layer 3 comprises a first tread rubber portion 3a and a second tread rubber portion 3c having a low electric conduction, and an electrically conductive band 3b having a high electric conduction and arranged in a middle portion of the tread rubber in a widthwise direction of the tire, in which each of the first and second tread rubber portions 3a, 3c is made of a low-conductive continuous rubber ribbon 13 circumferentially wound plural times, and the electrically conductive band 3b is made of a high-conductive thin annular rubber sheet.

[0034]

Similarly, the cap tread layer 4 comprises a first tread rubber portion 4a and a second tread rubber portion 4c having a low electric conduction, and an electrically conductive band 4b having a high electric conduction and arranged in a middle portion of the tread rubber in a widthwise direction of the tire, in which each of the first and second tread rubber portions 4a, 4c is made of a low-conductive continuous rubber ribbon 14 circumferentially wound plural times, and the electrically conductive band 4b is made of a high-conductive thin annular rubber sheet.

[0035]

Each of the sidewall 7 and the belt 6 is made of a high-conductive rubber material, while the tread under cushion 5 made of a conductive rubber material, the electrically conductive band 3b in the base tread layer and the electrically conductive band 4b in the cap tread layer 4 are contacted with each other in a region ranging from the belt 6 to a treading face F to form a conductive path, whereby a conductive path is surely formed from a wheel to be mounted with the tire 1 to the treading face F, so that even if the tire is stopped at any rotating position, static electricity generated in a part of a vehicle can be discharged from the treading face F through a vehicle body, a wheel shaft to be mounted with the tire 1, and a wheel to the road surface.

[0036]

In the first tread rubber portion 3a of the base tread layer 3, a side face 16a contacting with the electrically conductive band 3b is formed so as to orient outward in the radial direction and an inclination angle thereof with respect to an equatorial plane Q is 45-75 deg. The electrically conductive band 3b is connected to both ends of the side face 16a in the radial direction so as to extend over a widthwise region ranging from a part of a top face 18a of the first tread rubber portion 3a toward a part of a bottom face 17a of the second tread rubber portion 3c. Similarly, in the first tread rubber portion 4a of the cap tread layer 4, a side face 16b contacting with the electrically conductive band 4b is formed so as to orient outward in the radial direction and an inclination angle thereof with respect to the equatorial plane Q is 45-75 deg. . The electrically conductive band 4b is connected to both ends of the side face 16b in the radial direction so as to extend over a widthwise region ranging from a part of a top face 18b of the first tread rubber portion 4a toward a part of a bottom face 17b of the second tread rubber portion 4c. Thus, even if the positions of the electrically conductive bands 3b, 4b in the widthwise direction are shifted with each other due to the scattering in the production, the electric continuity between these tread layers or to the tread under cushion 5 can be ensured.

[0037]

The low-conductive continuous rubber ribbon 13 constituting the tread rubber has a width of 5-30 mm and a thickness of about 0.3-3.0 mm, while the high-conductive thin annular rubber sheet constituting the electrically conductive band 3b, 4b has a volume resistance at 25 deg. C of not more than 10<6> m and is preferable to have a thickness of 0.3-2.0 mm.

[0038]

Then, the production method of the tire will be described. The tire 1 shown in FIG. 1 can be obtained by vulcanizing an uncured green tire. The method of forming the uncured tread layer in the green tire is explained with reference to FIGS. 3-6. FIGS. 3 and 4 are schematically section views of the green tire explaining the formation of the tread layer along the formation process, and FIG. 5 is a schematic view showing the method of forming the uncured tread rubber, and FIG. 6 is a schematic view showing the method of forming the uncured electrically conductive band.

[0039]

As shown in FIG. 3(a), an uncured first tread rubber portion 23a constituting an uncured base tread layer 23 is firstly formed on a periphery of a tire raw member 21 previously attached on a building drum B and comprising uncured bead material, carcass material, innerliner material, belt material and tread under cushion material. In the formation of the uncured first tread rubber portion 23a, as shown in FIG. 5, an uncured continuous rubber ribbon 15 extruded through an extruder E is pushed on the tire raw member 21 previously formed on the building drum B through rolls R while rotating the tire raw member 21 and wound therearound plural times.

[0040]

Then, as shown in FIG. 3(b), the uncured electrically conductive band 23b is formed on the outer periphery of the tire raw member over a widthwise region ranging from a part of the top face 28a of the uncured first tread rubber portion 23a through the side face 26a of the uncured first tread rubber portion 23a to the outer peripheral face 27a

of the tire raw member 21 connecting to the side face 26a. As shown in FIG. 6, the uncured electrically conductive band 23b is formed by winding an elongate thin high-conductive uncured rubber sheet 16 guided through guide rolls R5 on the outer peripheral faces of the uncured first tread rubber portion 23a and the tire raw member 21 one times. In this case, since the outer peripheral surface comprised of the uncured first tread rubber portion 23a and the tire raw member 21 is not flat, in order to attach the uncured rubber sheet 16 onto the outer peripheral surface of the tire raw member with no space, it is preferable to push the uncured rubber sheet 16 by using a push roll R2 pushing onto the top face 28a, a push roll R3 pushing onto the side face 26a and a push roll R4 pushing onto the outer peripheral surface 27a of the tire raw member 21.

[0041]

After the formation of the uncured electrically conductive band 23b, the uncured second tread rubber portion 23c is formed by circumferentially winding the uncured continuous rubber ribbon 15 plural times as shown in FIG. 3(c). The uncured base tread layer 23 is completed through the aforementioned steps. Similarly, as shown in FIG. 4(a), the uncured first tread rubber portion 24a of the cap tread layer 24 is formed on the periphery of a tire raw member 21A consisting of the tire raw member 21 and the uncured base tread layer 23 by circumferentially winding the uncured continuous rubber ribbon 15 plural times, and then the uncured electrically conductive band 24b is formed by winding the thin high-conductive uncured rubber sheet 16 one times as shown in FIG. 4(b), and finally the uncured second tread rubber portion 24c is formed by circumferentially winding the uncured continuous rubber ribbon 15 plural times as shown in FIG. 4(c). In this case, it is important that the uncured electrically conductive band 24b in the uncured cap tread layer 24 is contacted with the uncured electrically conductive band 23b in the uncured base tread layer 23 over the full periphery to ensure the electric continuity.

[0042]

Moreover, the thin high-conductive uncured rubber sheet 16

can be formed in a thin form by rolling through a calendar or the like. The thus formed elongate sheet may be directly fed from the calendar onto the tire raw member and wound therearound to form the uncured electrically conductive band, or once the rolled elongate sheet is reeled, it may be used by reeling off. Similarly, the uncured rubber ribbon 15 extruded through the extruder E may be reeled and then used by reeling off instead of the case that the uncured rubber ribbon 15 is directly taken out from the extruder E and wound on the tire y raw member.

[0043]

[Effect of the Invention]

As seen from the above, according to the tire of the invention, the tread rubber is made of the low-conductive continuous rubber ribbon circumferentially wound plural times, and the electrically conductive band is made of the high-conductive thin annular rubber sheet, so that the tire uniformity is improved and the production is possible in the multi-size mixed production system. Also, the thickness of the electrically conductive band in the widthwise direction can be controlled to a minimum.

Furthermore, the electrically conductive band is arranged so as to extend in the widthwise region ranging from a part of the top face of the first tread rubber portion to a part of the bottom face of the second tread rubber portion, so that the conductive path from the belt to the treading face can be surely formed at a low cost.

[Brief Description of the Drawings]

[FIG. 1] FIG. 1 is a meridional section view illustrating a tread portion of a tire in an embodiment of the invention.

[FIG. 2] FIG. 2 is a section view illustrating a detail of a portion "d" in FIG. 1.

[FIG. 3] FIG. 3 is a schematically section view of a green tire on the way of the formation explaining a method of forming a tread layer.

[FIG. 4] FIG. 4 is a schematically section view explaining a step followed by FIG. 3.

[FIG. 5] FIG. 5 is a schematic view showing a method of producing an

uncured tread rubber.

[FIG. 6] FIG. 6 is a schematic view showing a method of producing an uncured electrically conductive band.

[Description of the Reference Symbols]

1 Tire

2 Tread

3 Base tread layer

3a First tread rubber portion

3b Electrically conductive band

3c second tread rubber portion

4 Cap tread layer

4a First tread rubber portion

4b Electrically conductive band

4c Second tread rubber portion

5 Tread under cushion

6 Belt

7 Sidewall

13,14 Low-conductive continuous rubber ribbon

15 Uncured continuous rubber ribbon

16 Thin high-conductive uncured rubber sheet

16a,16b Side face of the first tread rubber portion

17a,17b Outer peripheral face of the second tread rubber portion

18a,18b Outer peripheral face of the first tread rubber portion

21 Tire raw member

23 Uncured base tread layer

24 Uncured cap tread layer

23a,24a Uncured first tread rubber portion

23b,24b Uncured electrically conductive band

23c,24c Uncured second tread rubber portion

26a Side face of the uncured first tread rubber portion

27a Outer peripheral face of the uncured second tread rubber portion

28a Outer peripheral face of the uncured first tread rubber portion

B Tire builder

E Extruder

F Treading face

Q Equatorial plane

R Rolls

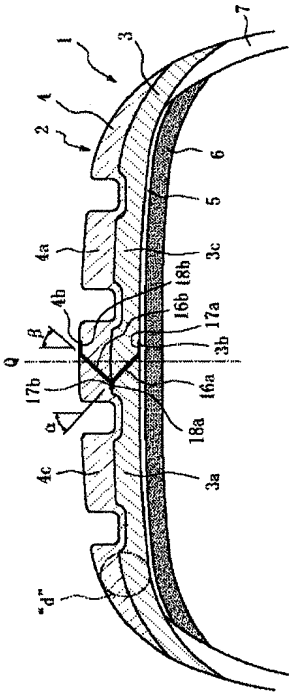
R2,R3,R4 Push roll

R5 Guide rolls

[Identification of Document] DRAWINGS

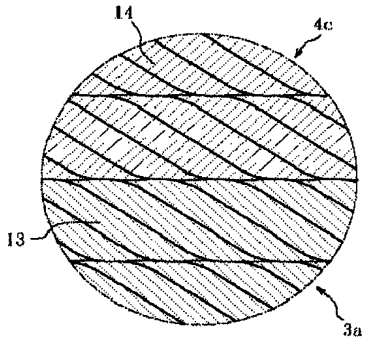
【図１】

[FIG. 1]



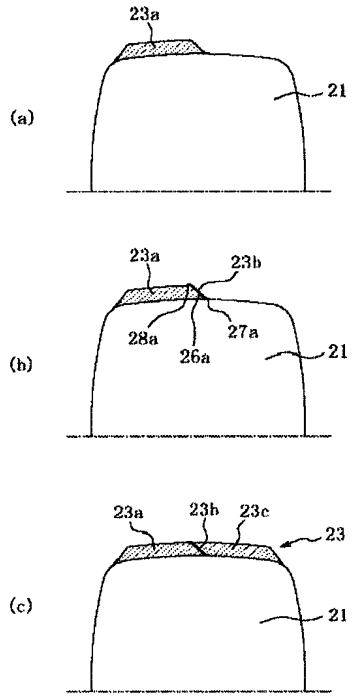

【図２】

[FIG. 2]



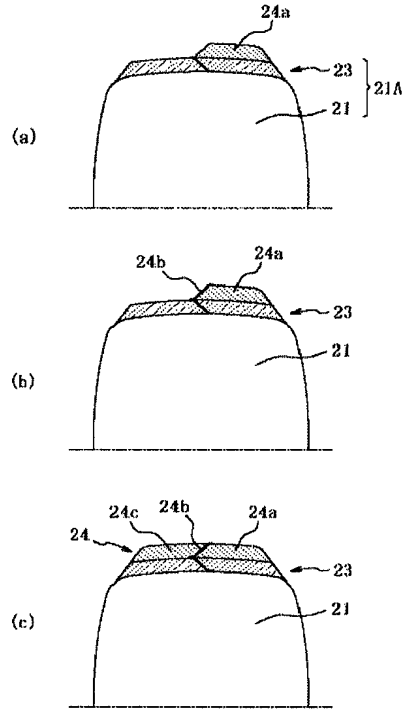

【図３】

[FIG. 3]



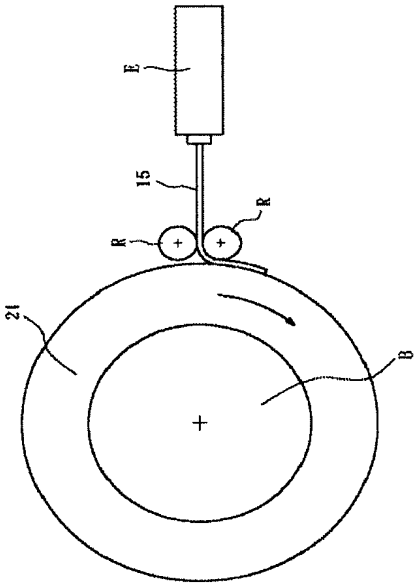

【図４】

[FIG. 4]



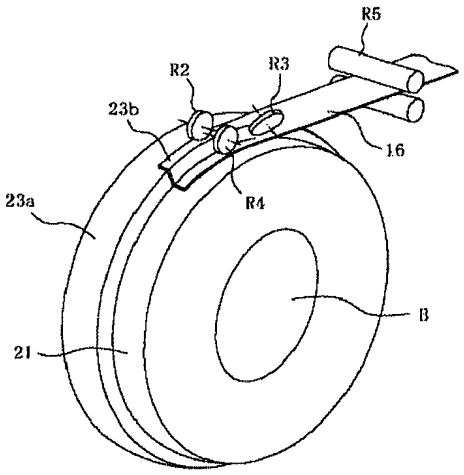
【図５】

[FIG. 5]




【図６】

[FIG. 6]



[Identification of Document] Abstract

[Abstract]

[Problems to be Solved] A tire and a method of producing the tire, where the tire has a tread layer constituted of tread rubber and a conductive belt provided in an intermediate portion in the width direction of the tread rubber. The structure above improves tire uniformity and enables the tire to be produced in a multi-kind mixed production system. Further the thickness in the width direction of the conductive belt can be constrained to minimum, and a conductive path from the belt to a tread surface can be formed reliably and at low cost.

[Solving Means] The tread rubber is constructed from a low conductive continuous rubber ribbon circumferentially wound plural times, and the conductive belt is constructed from a highly conductive thin annular rubber sheet. The conductive belt is provided so as to extend in a width direction region from a part of a top surface of a first tread rubber portion up to a part of a bottom surface of a second tread rubber portion.

[Selected Figure] FIG. 1